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THE
MATCH INDUSTRY
IN INDIA

BY
KIRAN CHANDRA SEN

TO

THE HON'BLE JUSTICE

Sir Asutosh Mookerjee, Esq.,

C S I, M A, D L, D Sc, Ph D, &c

Whose large-hearted and patriotic sympathy has not only espoused the cause of the advancement of learning for which his name is now a house hold word in Indian homes but has associated itself with all enterprises connected with the economic development of our dear mother land

THIS BOOK IS DEDICATED

IN TOKEN OF THE

highest admiration and gratitude of its

HUMBLE AUTHOR

FORWORD

We all agree that India needs industrial development and needs it on the lines of cottage industries. India is practically a country of peasant proprietors. Whatever may be the advantage of that condition, the evil inseparable from it, is a form of unemployment—that namely of the man with too little land to occupy him fully and to be cultivated economically on the lines of an ordinary holding. The remedy for this is the development of village industries. A man with some kind of industrial employment, and just a little land to grow certain things for himself and perhaps some more to let to a neighbour to cultivate along with his own, for payment, preferably in kind may, however, be very well off. The needs of the masses of the people in India are very few but matches are among the products of industries they all use. It is appropriate, therefore, that every effort should be made to solve the problem of the production of matches by cottage industry, and a great deal has already been done in this direction by the machinery, described in this book.

I have had occasion to enquire very closely indeed into the question of the profit to be expected from the match making in the manner described. I have found at least one disinterested authority, who says that, properly managed, it can yield a livelihood under true cottage industry conditions for very small capital outlay.

. There is a great deal of controversy on the subject. Some take a very optimistic view and others a very pessimistic one. Whilst, however, the optimistic may not allow sufficiently for the various losses that are inseparable from all industries, I have it on good authority that the pessimistic views are based on the experience of people who have not had sufficient knowledge or have not exercised sufficient care or who have not worked under the economic conditions of the true cottage industry. We may hope that this industry may develop so as to serve two of the most useful purposes in India, namely, those of solving the problem of peasants with too little land and of giving occupation to the middle classes.

It, therefore, deserves the most careful study.

It is with a great pleasure that I have undertaken to write an introduction to this book which my young friend Mr. Sen has taken such pains to compile with, a true desire to help his country and I hope that, in these days when the question of its economic development is so much to the fore, his patriotic fellow countrymen will not only appreciate the practical and constructive turn of his patriotism, but imitate it. This little book and the spirit that inspired it are typical of what is needed at the present moment.

CALCUTTA,

The 1st August, 1923

J. W. PETAVEL,
*Principal, Maharaja of Kasim-
 bazar's Polytechnic Institute and
 Lecturer, Calcutta University*

PREFACE

Although of a comparatively recent origin, match-manufacturing in India with machinery made in the country, has proved to be a profitable means of livelihood for those who can bring some capital to it and has opened up an opportunity of earning wages to poorer people

India is not the land of the big factory but essentially of the cottage industry which alone can give employment to large numbers of people of our country and change the mentality of the middle classes who now seem to think of nothing but service

Having watched the progress of the industry almost from its inception, I am convinced that the ever-increasing discontent due to unemployment, specially among our educated countrymen may, at least to some extent, be allayed if the industry is taken up with the thoroughness that leads to success. If it is done it may confidently be hoped that, in course of time, more and more people will become interested in it and will eventually be induced to choose business as their means of subsistence

An attempt has been made in this book to represent, as faithfully as possible, the prospect of the match industry in our country under the cottage system and I shall consider my labour amply rewarded if it leads more people to seek livelihood in this and other similar pursuits

7, BISWAKOSH LANE, BAGBAZAR, <i>Calcutta, July 21, 1923</i>	} KIRAN CHANDRA SEN
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.. .., there is a great future before the match-making industry in India.

R. S. TROUP.

The total quantity of matches imported into India
in 1922 **11,775,120 gross.**

The price we paid for it **Rs. 3,52,37,012.**

THE MATCH INDUSTRY IN INDIA

CHAPTER I

The Match Industry with Indian Dr Nandi. machinery is inseparably associated with the pioneer work of Dr Mahendra Chandia Nandi of Kalikachha, Tipperah whose persistent efforts helped by his natural genius for invention, have made match manufacturing profitable in India Dr Nandi is one of those few who have followed the maxim of 'plain living and high thinking' and are always ready to subordinate their personal interests to the good of the public

From his boyhood he developed a taste for devising cheap and handy machinery particularly suitable for cottage industries in the growth and extension of which, he believed, lay the salvation of our

country. In his early youth, he organised a small workshop for carrying out experiments, where he often used to shut himself up and work for hours together forgetting everything else.

Such devotion and perseverance were sure to lead to success, and it is only natural that Dr. Nandi's silent work should not have been vain. He gradually succeeded in devising a number of cheap and useful contrivances, all of which were specially suitable for cottage industries. But this is not the occasion to refer to these things, they being outside the range of the subject to be dealt with in this book. It will, however, interest many to learn that he has not reserved his rights to his inventions by patenting them and is ever ready to render every possible help to all willing to utilize them in the best interests of the country.

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The idea of inventing a handy machine at a small cost for making matches, wherein wood of any ordinary quality could be used, had engaged his attention towards the end of the last century, and, after having conducted experiments for a long time, he succeeded in devising one answering his purpose

The invention of machinery for manufacturing matches.

The machine, thus invented by him, was of a lever type, and could be fed with rectangular wood-blocks, pressed forward by means of a weight, against a knife, moving up and down, and could cut box veneers and splints for about six gross of match boxes per day

He was not, however, slow to recognise the importance of the wood problem in connection with this industry, and his experiments for the solution of it having proved satisfactory, he presented his machine to the public at an exhibition held at Rangpur in 1916, and at other

public places on similar occasion. Although it was welcomed everywhere, it did not attract such serious attention of the public as it so eminently deserved for having brought within a measurable distance the prospect of effecting a large annual saving, amounting to several crores of rupees and thus preventing the money from being drained away from our country to Sweden and Japan

But there was a long-standing prejudice against this industry, due specially to the want of sufficient success achieved by some of the then existing match-factories in India, all of which had been equipped at great costs with machines imported from abroad. So, Dr. Nandi had an immense difficulty to fight against prejudices and convince people that, if carried on with his cheap machines, the industry had a bright prospect,

inspite of the apparent crudeness of its method.

Dr. Nandi was not a man to be easily disappointed or disheartened. His heart, on the other hand, was filled with joy as he foresaw such great possibilites in his invention.

He went on improving his machinery, adding to the list of woods which he found suitable by experiment and giving demonstration to the public to arouse interest in the industry.

But he was opposed to the idea of trumpeting his invention by advertisements in or by contribution of articles to newspapers, and, therefore, the message of hope did not first go beyond the limited area in the neighbourhood of his workshop where the value of his work was practically demonstrated and needed no explanation.

Mr. Kamaniya Kumar Sinha of the Comilla Pioneer Iron Works,

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a relation of Dr. Nandi, who was the first to realise the far-reaching prospects of the industry, volunteered to manufacture the machine in his factory for sale. But it was sometime after, as I shall have occasion to mention by and by, that a general appreciation of the possibilities of the industry could be awakened and the business could occupy a proud position in the market as it does to-day.

I shall now give below a fuller account of the machine, thus sold by Mr Sinha. It was a hand machine of a small size weighing only about three maunds. By the different adjustments of a knife and a scoring bar, it could turn out different articles, necessary for the manufacture of matches, such as, splints, box veneers and veneers for inner trays. The capacity of one machine, as I have already mentioned, was about six gross per diem;

but if three machines could be set up in a factory and driven simultaneously, the delay in the matter of adjustment and re-adjustment of the parts of the machine being avoided, the daily output could be raised to about twenty-five gross. The special feature of the machine was that, its price being cheap, it could be bought and worked even in many of our villages by men with a capital of a few hundred rupees, enabling them to supply the local demand. As any sort of soft wood with straight fibres, available almost everywhere in the country, could be used in this machine, the necessity of selecting a factory site, close to forest, was no longer considered to be of paramount importance. A factory, yielding such small out-turn, could be established almost everywhere, local wood being sufficient for its requirement, if attention, where

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necessary, were simultaneously given to the plantation of new timber in the depleted area

For some time the progress of the industry was rather slow and Mr Sinha lost money by his share in it Up to this time however, the machine was faulty and difficulties were often experienced in working it,—so there was an urgent need of improving it with a view to removing the difficulties

In order to trace the development of the industry it seems necessary to mention here certain facts for information of those actually interested in the subject, which others can pass rapidly over if they do not care for details

Towards the close of the year 1920, an enterprising young man, Mr Taraninath Gupta M A, who paid a visit to Mr K K Sinha at Comilla was requested by the latter to undertake the sale of all

the products of his workshop as a commission agent in Calcutta. Of all the things, manufactured there the match machine struck him most as opening possibilities of business and the offer was accepted. On his way back to Calcutta he halted at the Govinda Match Factory at Narainganj equipped with Di Nandi's machine and was deeply impressed when the various processes of manufacturing matches were shewn to him, and he resolved to arouse public interest in the matter.

Coming back to Calcutta he started a selling agency and called it 'The Bhowani Trading Co'. Next, he wrote a long article dealing with details of match making as he had seen it at the Govinda Match Factory and got it published in the leading Bengali magazine, the 'Bharat-varsha'. Soon after, the 'Amrita Bazar Patrika' gave

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prominence to a correspondence dealing with the prospects of the industry, wherein Mr Gupta was referred to for detailed information on the subject

Letters of enquiry poured in from all sides Mr B C Nandi, the eldest son of Dr Nandi, was then in Calcutta, and when all these letters were placed before him by Mr Gupta, who did not know what action to be taken on them, the former made up his mind to start manufacturing match machines in Calcutta He took away all these letters had a prospectus printed and sent a copy to all enquireis Soon after he formed a Company and began to manufacture and sell the machine altering it in some minor details

The results, now obtained, were more than satisfactory, as a demand for the machine, from this time onward, began to increase

steadily, offering at last a long expected market to the manufacturers of match machines

Mr Gupta certainly did not watch the change in the outlook of the industry as a silent spectator, content with the facilities provided by Dr Nandis invention, and improved upon by his son. He was engaged, as a serious student of the industry, in thinking out ways and means to get further improvements effected. It was apparent to him that the load pressure by means of which the wood block was made to reach the moving knife was one of the serious defects of the machine, as no uniformity of thickness of splints and veneers could be controlled under this system. The method of working the machine by a handle attached to it by raising it up and pushing it down seemed to him quite unsatisfactory as it

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required great physical strength and was tiring. There were many other inconveniences, the removal of which was considered highly desirable in order to make the industry successful in all respects.

Soon after Mr Gupta made the acquaintance of an engineer, Mr Harish Chandra Roy, who had exceptional abilities and mechanical skill and was just the proper man to help him improving the machinery. Both of them soon decided upon a line of action and approached Mr Sinha of Comilla with a proposal to join them in founding a match machine manufacturing firm in Calcutta. Mr Sinha having consented, they established a firm named 'The Bhowani Engineering and Trading Company', an extension of the original one which had all this time been merely a selling agency. And it is no

exaggeration to say that the solution of the initial difficulties in improving and introducing the machine for purposes of trade in our country was chiefly due to the untiring zeal and indefatigable energy of these two young men who were latterly assisted in their laudable work by others to be named later on.

CHAPTER II

Before proceeding further, it will be useful to recall the reasons for the lack of success of some of the large match manufacturing factories, equipped with foreign machines and established in the different parts of India as a first step towards the solution of the problem of home supply of matches. Mr R S Troup, who dealt with the subject in a comprehensive manner in his book on the 'Prospects of Match Industry in the Indian Empire', published in 1910 under the authority of the Government of India attributed the reasons of failure to—

(1) want of proper selection of factory site and

(2) want of good expert advice

With regard to the reason No (1), Mr Troup says, The choice of a

suitable site is a most important matter in establishing a match factory, but it is a matter which has been overlooked in the cases of several existing Indian factories

'In one existing factory the supply of timber which is brought a long distance by sea in boats has to depend largely on the state of the weather, supplies ceasing in stormy weather, the factory has no provision for water storage and is, therefore, so to speak, at the mercy of elements. Another factory obtains its timber at extremely low rates in the forest but owing to the long distance it has to be transported by road or rail, the price of the timber becomes unnecessarily high by the time it reaches the factory. A third factory has been established without sufficient consideration of the question of an adequate supply of the timber, and after working some time it has been found that

timber supplies are running out. Numerous enquiries which I have received from various firms and persons frequently show a total disregard for the essential conditions in choosing a match factory site, a common mistake being to propose the establishment of a factory in some large towns often 100 miles away from the forests which supply timber, it being forgotten that timber is a very bulky and costly article to transport '.

Ordinarily the capacity of a match-factory, equipped with German machines, is 700 gross per diem. This requires a constant supply of a very large quantity of match woods, and hence we find so much stress being laid on the choice of a factory site, and the establishment of a factory, close to, forests with facilities for transport of timber, regarded as one of the most important requirements.

With regard to the reason No (11), it must be admitted that, apart from strict personal supervision of work in all the departments of the factory which is essential, the complicated foreign machines necessitate the employment of experts, specially trained in handling them and capable of attending to all kinds of repairs, since any defect, unless it is at once removed is sure to bring the working of the whole factory almost to a standstill.

The cost of starting a well-equipped factory with machines imported from abroad amounts to many lakhs of rupees, which does not permit any large extension of the industry. According to Mr Troup there was room in 1910 when his book was published, for the establishment of at least 70 factories in India in addition to the then existing ones, each with a capacity of about 700 gross per diem.

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But why is it that not a single such factory has been started since the publication of the above work in which a minute examination of the whole question of manufacturing matches in the Indian Empire was made, indicating the necessary precaution to ensure its successful working ? I think the reasons for general inaction in the matter are as follows

1 There is a very small number of people in India who can invest the necessarily large capital in the industry, and unfortunately those people have not all business aptitude. Besides capitalists with means and capacity may live far away from the forest and in the absence of a sufficiently enterprising spirit amongst us in general, we cannot expect them to establish factories away from civilisation and launch in what is still believed to be a risky experiment

2 The labour problem in places remote from populous towns cannot be overlooked. Organisers of match-factories are not blind to the fact that though the problem of wood supply is surely a very important one, the question of labour is certainly not a negligible factor, and we are all aware of the general tendency of our workmen to live in or near populous towns. In a word the factory workers flock to the towns and the rural population is busy in the fields. So the question whether it was prudent to establish a factory in a town for the sake of labour or in the neighbourhood of forests for the sake of cheap and abundant wood, must have offered a no less perplexing problem to the intending organisers of match factories in India.

3 Lastly, the want of sufficient success among the factories already

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established, must have tended, to a great extent, to discourage any new ventures in the direction

India, more over, is specially suitable for the expansion and development of cottage industries. People with small capital and landed interest always prefer business to service, especially because the latter requires them to quit their home land, they are ready to invest their money in any industry which can be carried on in or near their dwelling, provided a safe return of sufficient profit is assured. This kind of work appeals all the more to them because it places them in a position of independence instead of that of dependence on a master.

The question may arise why the work should not be undertaken by limited liability companies. The answer is partly derivable from the reason No. 3, mentioned above,

and partly from the fact that co-operative concerns with limited liability have not yet succeeded in inspiring the fullest confidence of our people on account of their frequent failures

All these circumstances have only strengthened the position of cottage industries in our country and hence we find people gravitating enthusiastically to anything that offers them a scope for the extended application of this sort of business

Dr Nandi understood the mentality of his countrymen long ago and therefore when the question of establishing more and more match factories with foreign machines on a large scale, was being discussed everywhere, he had been quietly thinking out plans for the solution of the problem from the most practical point of view, regard being had to Indian conditions

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in particular. And in spite of the aloofness of large capitalists from the enterprise it is a well-known fact that the country has been able to make a considerable progress in manufacturing matches locally according to Dr Nandi's system, justifying our fondest hope of being supplied with every match such that we use from indigenous sources within a near future.

After this brief survey of the position of large factories and the prospects of match-manufacturing on the cottage industry scale, I must pass on to a chapter on the improvements made upon the original invention of Dr Nandi by the competing builders of match machines.

CHAPTER III

The companies, I have named in the previous chapter, which had already been manufacturing and selling match machines, succeeded, within a short time in arousing a keen public interest in the industry and people from all parts of India began to visit them to gain a first-hand knowledge of the working of a factory equipped with Indian machines. Consequently, a few more match manufacturing establishments soon came into existence in addition to those which had already been working.

Gradually the Ghatak Iron works, Behala which formerly used to manufacture rice husking machines, oil mills, etc., came forward to participate in the business and began to manufacture and sell match machines as well. Another factory,

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the House of Laborers, soon sprang up at Comilla, and the Pioneer Iron Works there discontinued building match machines

So there were now altogether four manufacturers of match machines in the field, namely,

(i) Messrs. B. C. Nandi & Co. Calcutta,

(ii) The Bhowani Engineering and Trading Co., Calcutta ,

(iii) The Ghatak Iron works, Behala ; and

(iv) The House of Laborers, Comilla.

The spirit of competition which has ever since influenced the activities of some of these companies has, to say the least, been wholesome to the industry ; for, it would have certainly taken a longer time to have all the improvements effected on the original machine, had there been a fewer or no competitors at all.

I will recapitulate below some of the advantages and disadvantages of the original machine to convey a clear idea of the effects of the various improvements subsequently made

(1) A factory could be established in any part of the country without much restriction for even if it were equipped with three machines yielding an output of 25 gross per diem, the quantity of wood required for its working could have been available almost everywhere any kind of soft and cheap wood with straight fibres being suitable for this machine

(2) The necessity of boiling wood could largely be dispensed with For there was no need of stocking timber, causing it to be dried up as is necessary in the case of a big factory for which wood has to be brought in large quantity from a long distance Wood required for this machine being of a small

quantity at a time and always available in the locality under the conditions, I have already stated, could be obtained for use, when green

(3) No special expert with any large salary was required to be engaged in a small factory as the machine being of a simple mechanism could be handled by one with a couple of months' workshop training given by manufacturers of match-machines to their customers

Against the above, however, the following disadvantages, as found from experience of the original machine, are detailed below. But these disadvantages, be it said to the credit of the manufacturers of match machines, have now been effectually removed and an immense prospect has been opened to people, interested in the industry

(1) The working of the original machine, as I have already stated, was fatiguing

(2) Uniformity of the thickness of splints and veneers could not be obtained

(3) The output of a machine was very small even for the cottage system

(4) The cost of sizing wood blocks was dearer owing to smaller blocks being required for use in this machine

But inspite of these circumstances a great keenness was displayed in every part of the country to give the industry a fair trial and the number of small factories went on increasing, the demand for machines not diminishing even when they were found defective. Almost all the manufacturers of match machines had more orders than they could possibly supply. This was no doubt a hopeful but yet an

embarrassing situation inspite of which they were able to devote a considerable part of their time and attention to improving the machinery for which they deserve our grateful thanks. In their earnestness to improve, they seem to have been actuated more by a sense of duty towards their country than by a purely commercial motive. Mr. Roy of the Bhowani Engineering and Trading Company is well-known to me personally and I have nothing but admiration for this young man for the untiring energy and enthusiasm by which he was inspired to improve the machine.

The machine improved by him includes the following features of its own among others

(1) The original lever type machine was changed into an automatic rotary type and it could be driven by hand by means of a fly wheel or by power.

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(2) When driven by hand the operation was less fatiguing

(3) The load pressure for pressing the wood block forward being no longer required a uniformity of the thickness of splints and veneers was guaranteed under its automatic arrangement

(4) Driven by hand it could cut splints and box veneers for about 20 gross per diem and more if driven by power

(5) All the parts of the machine were more or less stronger than those of the original lever type machine

All these new advantages added to the possibilities of the industry, and notwithstanding the difficulties, experienced in the rains, particularly in damp places, which I shall have occasion to dwell upon hereafter there was a tremendous rush in the market for the improved type

Soon after the Comilla House of Laborers succeeded in bringing forward its improved type of machine followed almost simultaneously by the Ghatak Iron Works of Behala and curiously enough all these competing manufacturers must have been thinking on the same line as the improvement upon the original made by them was almost similar in principle and in detail but I leave it to the match-manufacturers themselves to give their verdict on the relative quality and capacity of the improved types manufactured by the different Companies

I shall now pass on to deal with the next stage of improvement introduced in the machinery for manufacturing matches. Some time ago the Bengal Small Industry, Calcutta built a peeling machine, hitherto unknown and untried in any small factory in

India, for which it deserves the pioneer's credit in the field. Another machine of the same type was soon after devised by Mr H C Roy which is although same in principle as the one made by the above Firm is somewhat different in its arrangement of pinions etc. I should not however commit myself to any statement as to whether they have been made after the model of the similar machines, manufactured in Germany by Roller or Baden or whether the machine manufactured by the Bengal Small Industry is better or worse than that made by Mr Roy of the Bhowani Engineering and Trading Company but it must be said to the credit of the Indian manufacturers that their machines are cheap, simple and handy and are quite easy to manipulate. I saw them exhibited at the All India Exhibition held in Calcutta in January last.

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where they drew a large crowd of eager spectators when peeling a round block of wood into a long sheet of smooth and beautiful veneer like a bioscope film.

Some of the principal advantages and disadvantages of the machine are given below .

(1) This machine can peel box veneers for about 100 gross matches per working day of 10 hours and its output is of a better quality.

(2) It can be driven either by power or by hand, but as a block of wood has to be adjusted in it repeatedly after exhaustion its output cannot be increased to a very appreciable extent when driven by power.

(3) It requires even less exertion than the improved chopping machine to drive it by hand.

(4) Giving better work with less labour, it is economical.

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(5) The cost of sizing wood-blocks for use in this machine is very cheap as a trunk requires only to be barked and divided into pieces of measured length for the purpose

(1) Unless quite green, the wood has to be boiled for a considerable time before it can be used in this machine

Its disadvantages

(2) Although attempts are being made by the manufacturers of the peeling machines to overcome their difficulties in obtaining suitable veneers for splints, the problem still remains to be solved. I have heard from some of the leading match manufacturers that veneers, sufficiently good for splints, have not as yet been obtained by peeling ordinary wood which may be quite suitable for box-veneers if used in a peeling machine. The managing proprietors of certain match-factories working at first only

with peeling machines have subsequently provided their factories with chopping machines for making veneers for splints. A chopping machine is, therefore, necessary in a factory until its use is rendered superfluous by an improvement of the peeling machine.

In a previous chapter I have given reasons why no sufficient number of match-factories with foreign machines has yet been established in the country and I shall try to explain here why factories equipped with Indian machines, with their increased capacity of outturn, are expected to be established in a fairly large number in India inspite of all the disadvantages I have already mentioned.

These machines being cheap, they are accessible to people including those living in places, specially suitable for successful match-manufacturing purposes, who might

not take up the industry if the machines were capable only of yielding a small output. The foreign machines being costly fewer people would have entered the industry if they had to depend upon them.

In India forests are not confined to any particular area but are more or less scattered over the whole country, so there are places in almost every province where suitable match wood may be available in a tolerably large if not very large quantity. The peeling machine, on account of its cheapness and superior production, will be found useful even where it is not possible to utilize it to its fullest capacity on account of the insufficient supply of wood. Again, this machine being light it may easily be shifted from place to place in a forest to use green wood, if it could be arranged to

Division of
a match
Factory into
two depart-
ments.

send the produce for finishing to a place where labour is cheap and other materials are available. It does not require many people to run, a factory for chopping splints and peeling veneers for boxes ; less than a dozen workmen is sufficient to produce materials for 100 gross. Some of the workmen will drive the machines, some will collect wood from the neighbouring forest and the rest will pack up the produce. This will effectually solve the question of the supply of wood, dispensing, at the same time, with the necessity of boiling the timber. But in selecting a site for operation on these lines one must be thoroughly satisfied that it has proper facilities for transport.

A finishing factory may be a great success if a sufficient quantity of splints and veneers for boxes may regularly be obtained from outside. This kind of work will

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appeal to people (i) who live in places remote from forests and (ii) who, for want of sufficient experience in the work or for other reasons, may not like to start a fully equipped factory at once. Finishing factories may be largely organised in free schools, jails as also in orphanages and other charitable institutions. In view of the prospect of success of an undertaking of this nature, which requires a very small capital, it will be found worthy of being given a trial. The working of a finishing factory is all the easier for these institutions as children and inexperienced hands may largely be employed in it without the work losing its efficiency in the least.

1 'The work done in the above way will leave a sufficient margin of profit both for factories making splints and veneers in the forest as also for those finishing them in the

Prospects of both the departments—equally attractive

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town. So there is a very large scope for the expansion of this branch of the business. I have heard that there is already a demand in the market for splints and veneers which is sure to increase with the development of the source of supply.

CHAPTER IV

At present numerous types of improved automatic chopping machines are available in the market. Ordinarily the prices of these machines are determined by their capacity of output which varies from 8 to 50 gross per diem. A factory containing one large-sized chopping machine and a peeling machine, however, can produce materials for about 100 gross of match boxes per working day of ten hours if the machines are driven by hand, the chopping machine being employed for cutting veneers for splints as also splints and the peeling machine only for box veneers.

In this chapter I propose to confine my remarks to the method of cutting splints and box-veneers with Indian machinery, reserving the treatment of chemicals for manu-

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facturing matches to be dealt with in the following chapter.

Blocks of measured thickness from wood according to the requirements of the chopping machine are prepared with a hand or a cross-cut saw. They are then cut into small pieces, each measuring 10 inches in length (or smaller if the machine has a smaller blade.)

If the wood is not sufficiently green, the blocks are to be boiled till they are soft, the time required for boiling depending on the dryness of the timber.

Every moveable part of the machine must be greased. Sharpen the blade and adjust it to the machine. Let the machine-man now examine the machine and see if the guillotine has properly been adjusted and does not shake when the machine works. It should also be carefully

ascertained that the push-bar, ratchet, pinion and the driving-lever work smoothly without shaking.

Put one of the wood-blocks, already prepared, into the feed-box. Fit up the scoring bar, arranging its lancets, to the machine, and regulate the push-bar properly, so as to obtain the desired thickness of the veneers for boxes. Let one man (or two men if the machine is of a larger size) then drive the machine and another man collect the veneers and pile them up, back to back and front to front in groups, each group containing about 25.

To avoid accidents it is better to collect the veneers from near the operating zone of the machine with a rake, specially made for the purpose, instead of by hand.

After exhaustion of each block, the push-bar automatically stops, requiring a new block to be supplied

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to the feed-box. This should be done again and again till the requisite output has been obtained.

The scoring points of the lancets will now be required to be re-arranged and the push-bar re-adjusted to the machine so as to obtain scoring for, and proper thickness of, inner trays. The machine should then be driven in the usual way and the veneers arranged one upon another in the manner already indicated and divided in groups, each group containing 25. This should be continued till the necessary quantity of veneers has been obtained. Now remove the scoring bar, re-arrange its lancets to get scoring for bottom pieces, fit it again to the machine and drive it. The veneers are now to be collected and grouped in the above manner.

All these veneers are now to be sized and made ready for use by a chopping machine.

Remove the scoring bar from the machine but leave the chopping blade undisturbed. Put a wood-block into the feed-box and regulate the machine to obtain the desired thickness of the veneers for splints and drive it as before. Collect the veneers and pile them as above in groups, each group to contain about 60 to 80 such veneers, according to their thickness and the capacity of the feed-box and continue the operation till the necessary quantity has been turned out. Now re-adjust the scoring lancets and fix the bar to the machine. Fill the feed-box with the veneers, already arranged and kept in separate groups. Now as you drive the machine you get the splints.

N. B. By different arrangements of scoring lancets, matches of different sizes can be turned out.

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Soak the splints for about 5 minutes in impregnating solution (For preparation of impregnating solution vide the following Chapter on Chemicals)

Remove the splints to the polishing drum, and get it slowly revolved till the splints are perfectly dried, cleaned and polished

The splints are now to be transferred to the filling department to be filled in frames. When filled, one end of the splints will remain protruding a little. These ends are now to be pressed for a moment upon a plate of red hot iron to be carbonised. This may also be done by dipping the projected ends of the splints in frames into sand spread upon a flat tray and heated upon a fire. They are next to be dipped just for a moment in a flat tray containing hot and liquid paraffin. This done they are again to be brought for a moment in

contact with a partially heated plate. Now dip the ends of the splints into a tray containing composition for match heads (for preparation of this composition, vide the following Chapter on Chemicals) in which it is spread in a layer to an exact depth for tapping the heads of the splints.

After the splint ends have thus been dipped into the head composition the frames are to be left in the shade to dry for about half an hour after which they are to be taken to the drying chamber and placed there in racks with the tipped ends downwards and kept in that position for about half an hour.

N B The time required for this operation will depend on the temperature of the drying chamber a longer time may cause explosion while an inadequate drying may spoil the matches. A proper regulation of time and heat is therefore essential.

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It is needless to explain how to make boxes with scored veneers as it is done in a very simple way. The materials necessary for this work are wrapping papers,, paste and shaping moulds.

Arrange the boxes in side-painting frames each of which may contain, say one gross. The sides of these boxes should now be painted with chemical paste. (For preparation of this paste, vide the following Chapter on Chemicals) with a brush. Keep these frames on the roof of the drying apparatus for about twenty minutes for drying.

The inner trays are now to be filled with as many tipped splints as they can hold, the outer covers being dried and labelled before they are filled with inner trays containing the splints. These match-boxes are now to be packed up in bundles of one dozen in each. These should

finally be packed up in bundles containing half a gross or one gross of match-boxes according to the requirement of the market. These one gross or half gross bundles are now to be labelled before they are ready for despatch from the factory for sale.

The trunks of trees of the measured girth are to be cut into logs of measured length according to the requirement of the machine by a saw. They are to be boiled under certain conditions already mentioned. But soft green wood, fresh from forest, need not be boiled.

Adjust the knife and the scoring lancet of the machine which is to be thoroughly oiled and cleaned every day, and see that a uniform and proper working of the machine has been secured. When a log of wood is placed between the grippers of the machine, it will produce, as it is driven, a long sheet of

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veneer, duly nicked in, to form the folds of the boxes and again by a different arrangement of the scoring lancets it will peel off veneers for inner trays and bottom pieces. Each kind of veneers is to be cut at a measured length and piled one after another, each pile to contain about 20-25 sheets and sized by a chopping machine. By yet a different arrangement of the scoring lancets, veneers for splints may also be obtained. These veneers, piled as above, are to be cut into splints by a seperate splint chopping machine.

CHAPTER V

The following description of the chemicals for manufacturing matches occurs in Thorpe's Dictionary of Applied Chemistry, Vol. II.—

“Almost every match-manufacturer has his own special composition and way of preparing it, but the mixtures in use for ordinary matches invariably contain (1) an oxidisable body in a fine state of division and intimately mixed with (2) oxidising agents; (3) cementing or binding materials; (4) certain chemically inert bodies added to increase friction, (5) colouring matters.

The oxidising agents principally employed are potash chlorate, potash nitrate, lead nitrate, minium, manganese dioxide, lead peroxide: Potash dichromate,—oxidised minium (made by heating minium

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with nitric acid), ferric oxide and litharge must also be mentioned. In English matches potash chlorate is the customary oxidising agent used alone or with manganese dioxide etc. Potash nitrate is frequently present in Continental matches.

Glue, gum, gellatin, dextrine are the binding media mostly used. In Great Britain, glue is almost exclusively used. Powdered glass, chalk, gypsum and fine sand are among the in different bodies added. Prussian blue, ultramarine, smalt, vermilion, chrome yellow and coal tar are used for colouring mixtures.

This gives the general principle underlying the preparation of chemicals for match head composition. Different factories however, use different ingredients according to their own choice, the above general principle always holding with the

only exception that some of the factories do not use any special colouring matters, the colour of the other chemicals used being considered suitable

Seventeen Formulas for head composition are given in this chapter in explaining below as to how to handle chemicals and prepare the mixture, the ingredients used in formula No 8 have been dealt with

It must, however be always remembered that the ingredients should at first be carefully weighed and checked and proper precautions taken against fire

The paste must be used on the very day it is prepared Two sets of pestles and mortars, scales and spoons should be used, one set for preparing mixture for head composition and the other for side-painting paste They should be thoroughly washed after use every day

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Place glue or gum in cold water twelve hours before boiling. Put it in a pan and boil it till it is thoroughly dissolved.

Now remove the pan from the fire and when the solution gets cooler take a portion of it and pour it in a test tube. Drop a hydrometer into the tube and read the specific gravity. In all seasons of the year except the rains the reading of the meter at 1010 s.g. should be considered suitable for the purpose. In the rains, however, the specific gravity should reach 1060-65. If the meter indicates a higher degree of specific gravity hot water should be added to the solution and the pan placed on the fire to bring the former down to the required density. A portion of the solution is now filled again.

N.B. Glue should not be boiled in direct heat. A water jacket may be used to heat it warmed by steam.

into the test tube to ascertain the specific gravity. If, however, it appears that more water than is necessary has been added, place the pan again on the fire to make the solution thicker. By this way when the requisite specific gravity is arrived at, the solution will be considered fit for use.

N. B. Climatic conditions of certain places may require the solution to be made a little more or less thick.

Grind all the ingredients *separately* with a pestle and mortar till they are very fine; sieve them *separately* through a thick cloth and keep each ingredient in a *separate* jar.

Caution—After grinding each particular ingredient, wash the pestle and mortar, preferably with hot water, before using another.

It should be specially noted that even a small particle of sulphur, if present in the pestle or mortar, when grinding chlorate of potash, may cause explosion and all the

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other ingredients should at first be mixed and dissolved with glue before chlorate of potash is added.

Take two parts of sieved bi chromate of potash, one part of manganese dioxide and two parts of sand in a mortar and rub them with a pestle till they are thoroughly mixed. Add a little glue already prepared, just sufficient to melt the chemicals. Now add six parts of sieved potash chlorate and rub the composition thoroughly with a pestle.

The use of a grinding mill for mixing the chemicals is preferable.

Now examine the paste by dipping the end of a splint into it to see if it is sufficiently thick for the purpose.

NB—Do not add too much glue at first do it gradually and see that the composition does not become too liquid to be suitable. Experience will teach one how to do it.

Now remove the composition to the dipping vessel, a flat-bottomed tray with arrangements for keeping it hot by steam. Spread it there with specula and level it to the exact depth required for dipping, which can be ascertained by thrusting the end of a stick or a gauze into it.

The composition is now ready for use.

1

Chlorate of potash.....	1 part
Sulphide of antimony.....	1 part
Glue	2 parts
Water,	12 parts

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2

• Chlorate of potash4 parts
Bichromate of potash1½ „
Red lead4 „
Sulphide of antimony3 „
Glue and water to make a creamy paste.	

3

Chlorate of potash	...200 parts
Lead Binoride	...115 „
Red lead	...250 „
Antimony Trisulphide	...125 „
Gum arabic	... 67 „
Paraffin	... 25 „
Bichromate of potash	...132 „

Process of Preparation—Rub the antimony and paraffin together, then add the other ingredients. Add water to make the whole of a proper consistency and heated over a bath.

• Vide Spon's Encyclopaedia of Industrial Art.

4

Potash chlorate	...	6 parts
Antimony sulphide	...	2 "
Sulphur	...	1 part
Fine sand or glass powder		2 parts

—::—

5

Potash chlorate	...	6 parts
Manganese dioxide	...	$1\frac{1}{2}$ "
Sulphur	...	$1\frac{1}{2}$ "
Sand	...	2 "

—:—

6

Potash chlorate	...	6 parts
Potash Bichromate	...	1 part
Red Lead	...	$\frac{1}{2}$ "
Sand	..	2 parts

—○—

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7

Potash chlorate	... 5 parts
Potash bichromate	. . 2 "
Sand	... 2 "
Lamp black	... 1 part

—o—

8

Potash chlorate	... 6 parts
Potash bichromate	... 2 "
Manganese dioxide	... 1 part
Sand	... 2 parts

—o—

9

Potash chlorate	. . 6 parts
Manganese dioxide	... $\frac{1}{2}$ part
Antimony sulphide	... 2 parts
Sulphur	... $\frac{1}{2}$ part
Sand	... 2 parts

—o—

10

Potash chlorate	4 parts
Potash bichromate	$1\frac{1}{2}$ „
Red lead	4 „
Antimony sulphide	3 „
Sand	2 „



11

Potash chlorate	$6\frac{3}{4}$ parts
Potash bichromate	$\frac{4}{5}$ „
Ferric oxide	$\frac{1}{2}$ part
Manganese dioxide	2 parts
Sulphur	1 part
Glass powder	$1\frac{1}{2}$ parts
Glue	1 part



12

Potash chlorate	6 parts
Yellow ochre (<i>Gerumati</i>)	„
Sulphur	$1\frac{1}{2}$ „
Manganese dioxide	$\frac{1}{2}$ part
Sand	2 parts



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13

Potash chlorate	...	18 parts
Potash bichromate	...	1.6 "
Sulphur4 part
Manganese dioxide	...	1.8 "
Ferric oxide	...	1 "
Amber	...	1 "
Glass powder	...	2 parts
Gum arabic	...	4 "
Glue	...	1 part
—o—		

14

Glass powder	...	8.77 parts
Glue	...	7.12 "
Potash bichromate...	...	5.59 "
Potash chlorate	...	46.76 "
Ferric oxide	...	4.09 "
Manganese dioxide...	...	13.07 "
Sulphur	...	7.41 "
—o—		

15

Potash chlorate	18 parts
Potash bichromate	3 "
Sulphur	$\frac{1}{2}$ part
Red lead	3 parts
Sand	6 "

16

Chlorate of potash	18 parts
Bichromate of potash	2 "
Ferric oxide	2 "
Manganese dioxide	2 "
Glass powder	4 "
Sulphur	1 part

17

Chlorate of potash	15 parts
Bichromate of potash	2 "
Manganese dioxide	6 "
Glass powder	4 "
Sulphur	2 "

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NB Glue or gum should always be used to make the whole a creamy paste

In order to economise chemicals, the paste may be increased to the extent of 33—50 per cent by the addition of such substances as pumice, plastic clay etc *

Before entering into details regarding the preparation of composition for side painting the underlying principle as found in the Dictionary of applied Chemistry by Thorpe, (Vol II, P 422) may be given below —

‘The composition used in the special rubbing surfaces for safety matches are very various, but the ingredients chiefly present are red phosphorus, antimony sulphide and powdered glass made into a paste with glue The antimony sulphide is sometime omitted and manganese

* Vide Troup's Prospects of Match Industry in the Indian Empire, p 13

dioxide is not infrequently added to safety rubbers

There is no difference in the treatment of glue required for this purpose, as also for the purpose of head composition, except in the specific gravity which in the case of former, should be read 1025 1030 in all seasons of the year This requires no further explanation

Grind the chemicals separately and store them after sieving into separate jars Red phosphorus is to be dissolved in glue

Put $1\frac{1}{2}$ parts of manganese dioxide and 5 parts of antimony sulphide in a mortar and mix them thoroughly together Now add a little dissolved glue When they are thoroughly milled add glue and red phosphorus little by little till the whole has been intimately mixed

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Seven more formulas for side painting composition are given below :—

1

Amor phosphorus ... 3 parts
Managnese dioxide... $1\frac{1}{2}$ „

—o—

2

Amor phosphorus ... 5 parts
Oxide managanese ... 4 „
Dry glue ... 1-3 „

—o—

3

Amor phosphorus ... 2 parts
Powdered glass ... 1 part

—o—

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4

Red phosphorus	... 2 parts
Glass powder	... 1 part
Glue and water to make a paste.	

—:—

5

Red phosphorus	... 9 parts
Powdered pyrites	... 7 "
„ glass	... 3 "

—:—

6

Red phosphorus	... 3 parts
Manganese dioxide	... 2 "

—:—

7

Red phosphorus	... 2½ parts
Antimony	... 2½ "

—:—

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The following are some of the formulas for preparing impregnating solutions used to prevent matches from glowing after ignition —

1

* Solutions of sodium phosphate, sodium tungstate, zinc sulphate alum, ammonium sulphate and magnasium sulphate

2

* A solution of phosphoric acid and ammonium phosphate together or borax and ammonium phosphate.

^c *Vide Thorpe's Dictionary of Applied Chemistry, Vol 11 p 410*

3

†(a) $2\frac{1}{2}$ per cent. solution of ammonium sulphate,

† *Vide Spon's Encyclopaedia of Industrial Art*

(b) a solution of ammonium sulphate (2 per cent of this salt with 1 or $1\frac{1}{2}$ per cent of phosphoric acid)

The most ordinary method of impregnating matches is to soak them in a solution of 2 p c phosphoric acid (concentrated) This solution is good enough for the purpose

Put the solution in a tub Stir, fill the tub with rough splints before they are dried, cleansed, or polished Keep them there for about 5 minutes Now remove them to an open box with perforated bottom When water does not drip any more remove the splints from the box and place them in the polishing drum attached to the drying apparatus If more splints are to be soaked in the solution for the second and the third time, they are kept in it for

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about 10 to 15 minutes according to the strength of the solution .

The recipes for head composition and side-painting, included in this chapter, have not all been tried. Some of them, such as formulas nos. 16 and 17 for head composition and 6 and 7 for side-painting, have been experimented upon and found satisfactory. The suitability of the formulas, it must be borne in mind, depends, to some extent, on the climatic condition of the particular match-manufacturing province, and none can, therefore, be recommended for universal use. A particular formula, found specially suitable in one particular province, may appear defective in another, and it is, therefore, suggested that as many of them as possible should be tried and the best one made use of in a factory according to its special requirements.

Besides, no satisfactory result can ordinarily be obtained unless a judicious choice is made of the formula for side-painting paste to match the particular formula chosen for head composition.

Experience will, however, unfold the secret of success in these matters.

In damp places, there is a general complaint that matches do not ignite during the rains and are not largely sold and are consequently to be stored for disposal till the season is over. Although experiments for making damp-proof matches, conducted by some of the leading match-manufacturing houses, have been in progress for a long time the defect has not yet been satisfactorily removed ; but it is now believed that it will be partially, if not not fully, remedied in a near future. If the following

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directions are acted upon it may help our match-manufacturers to achieve some success in the matter.

1

Use first class glue. English glue should never be used. In the Dictionary of Applied Chemistry by Thorpe it is stated that much depends on the quality of the glue used and its drying properties.

The use of glue instead of gum is recommended in the Scientific American Cyclopaedia of Formulas by Hopkins.

2

Try to have a proper drying apparatus made. An exhaust fan may be used to remove moisture from the drying chamber. Splints

should be perfectly dried before they are dipped into the chemical solution

3

Perform the operation of grinding and mixing of chemicals in a dark room This has been recommended in the Scientific American Cyclopaedia of formulas by Hopkins

4

Use pure chemicals as far as possible

The use of gum and dextrine instead of glue for the preparation of composition for striking surface and a specially prepared paste for wrapping up match-boxes in blue paper are believed in some quarters to produce a satisfactory effect

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I have used matches manufactured by Mr N Chakrabarti MB from his factory at boalbari in the district of Tipperah, and they seemed to be damp proof

Mr U N Guha, proprietor of the Guha Lucifer Works Calcutta who obtained a gold medal for the matches made in his factory at the last All India Exhibition held in Calcutta, also claims to have succeeded in making damp proof matches These matches were highly spoken of at the Exhibition by the Consul Generals of Norway and Siam and a host of other distinguished persons There are many other match manufacturers such as the Cussins Match Works, Uldadanga Calcutta, and the Popular Match Factory, Calcutta both winners of gold medals at the above Exhibition the Bhowani Engineering and Trading Company, the National Match Factory, Calcutta,

the Leo Match Factory, Rajganjpur the Biswas Lucifer works Suni (C P), the Star Match Factory Lucknow, the Buttas Matches of Gohana, Rohtak, the Puri Match Industries whose success in making damp proof matches seems to be almost certain in view of the earnestness with which they are conducting experiments to solve the problem

Every match factory ought to have an expert on its supervising staff, accustomed to handle chemicals. The weighing grinding and mixing of chemicals should either be done by him or under his direct supervision. It may not be possible for small factories in villages to engage such experts in which case it is essential that the proprietors themselves should receive training in the work before the business is actually started.

CHAPTER VI

A list of suitable wood, used for manufacturing matches, specially in India and Burma is appended to this book (Vide Appendix A)

As the scientific names are not commonly understood, I have given only the vernacular names and this, together with the method of compilation that has been adopted will I hope make it easy for those interested in the subject to find out which kinds of wood are available for manufacturing matches in their respective localities

In compiling the list I had to depend largely on Troup's work on the 'Prospect of Match Industry in the Indian Empire' There are many species of wood, not mentioned in the above work, which have been tested and found suitable, their names, however, are

not available, since people, when sending woods for testing, do not, as a matter of fact, mention their names but call them A, B, C, D, etc. to differentiate one from the other and this causes their names to remain unknown to the general public. If the names of these woods were given, it would have enabled me to include them in the list for the benefit of those interested in the industry.

Before proceeding further I shall make some suggestions regarding wood which, being the most vital and precious thing in the system of match-manufacturing, demands the most rigid economy of use for the success of the industry. It requires no arguments to prove that the quantity of wood for the working of a factory may be reduced if it is possible to check waste. Now the question is what is the best way to achieve success in the matter.

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It is a common practice to throw away a match-box when it contains no more sticks. But if it fetches any value, the waste might be partially checked. I have heard it said by some manufacturers of matches that they can buy empty boxes if they are not damaged and are tendered in a substantially large quantity, say half a gross at a time. They can take them in exchange for half a dozen of filled match-boxes or on payment of a price, equivalent to its value. These boxes they hold may be used if they are relabelled and their sides are painted once more with chemical paste. If this view is shared by all, and the fact is widely circulated there is a prospect of some economy of wood being effected in this way.

We often burn a match to light a cigarette, a candle, a lamp, etc., these purposes are served even be-

fore one fourth part of a stick is actually consumed. But if the sticks are made a little longer, soaked in impregnating solution to prevent glowing after ignition and both the ends are tipped instead of one, we can utilize a match twice instead of once. It being a novel plan involving some trouble by having required the match to be extinguished after one of its heads has been burnt and returned to its box, there may be some difficulty in introducing it at first. But its cheapness being its main recommendation, it is expected to gain ground in the long run. Poor people may, however, use it from the very beginning.

At any rate these are experiments which may be given a trial in view of the magnitude of economy they promise.

It is desirable that wood, not sufficiently white, should be

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bleached For white splints are always preferred by consumers to coloured ones Bleaching is done by almost every match-manufacturer in countries outside India whereas in India this practice is not very common There are many processes for bleaching wood two of which are explained below —^e

1.

The splints are immersed in a bath of chlorine bleaching liquor for one to two hours In some cases where dilute liquor is used the splints are kept in it for twelve hours The chlorine liquor is prepared by mixing chlorate of potash with some hydrochloric acid and diluting the whole with water

* Vide The Report on the bleaching of some Indian coloured wood by Mr Puran Singh I C S incorporated in the Prospects of Match Industry in the Indian Empire by Mr R S Troup

After bleaching the splints in chlorine liquor, they are first washed with dilute sulphurous acid to remove chlorine then washed with water and then dried

For commercial bleaching the chloride of lime or bleaching powder, mixed with about one tenth of its weight of soda crystal (sodium carbonate) may be used as the source of chlorine The quantity of water to be added to this mixture depends upon the strength of the bleaching required-

2

The splints are immersed in a bath of permanganate of potash for one to two hours The bath is prepared by acidulating a 2 per cent solution of the permanganate with some dilute sulphuric acid The splints are then taken out and put in a weak sulphurous acid solution (obtained by acidulating a

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dilute solution of sodium sulphite with dilute sulphuric acid) until the blackening caused by the permanganate completely disappears from the splints. They are finally to be thoroughly washed with water and dried.

The chlorine process generally gives a satisfactory result and it is more commonly used, but it is suggested that both these processes should be tried when bleaching a new species of wood and the more suitable one noted for future guidance.

CHAPTER VII

From what has already been stated in the previous chapters and will be repeated and amplified in this one it will be seen that the best way in which our country can utilize its natural advantages for the manufacture of matches, lies in the extension of small factories on cottage industry scale and not in the establishment of a few big factories with questionable prospects of success. This industry is now in its infancy and in view of the peculiar conditions of our country it has to depend for its healthy and natural development more upon popular support than upon the efforts of a few large capitalists, and this is a point which ought to be specially noted.

It seems that manufacturers of match-machines, in their attempts

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to vie with each other in a race of competition, have been led by the idea that large productive capacity is the cardinal requirement for the development of the industry. But it cannot be ignored that a factory equipped with machines yielding a very large output is more or less exposed to the same risk of failure as the one with more powerful foreign machines. Ours is a country which is specially suitable for smaller factories, scattered in different places, each having a moderate output, sufficient for local consumption. The question of wood capital, labour, etc., will present less difficulty to smaller factories, as they will be able to carry on their work with local labour, and local timber, if plantation of wood for future use, as has been already stated, is simultaneously undertaken. Such factories are, in most cases, likely to be

managed by their proprietors, and, therefore, more efficiently and will make matches of a better quality, the interests of the managers thereof being thus directly involved in the business. Moreover, if the supply is locally consumed it will be possible for such factories to sell matches at a cheaper price, payment of transport and packing charges being thus avoided.

Large factories can only be established in places, where conditions are exceptionally favourable.

As failure will damp the awakening interest in the industry, large factories should be set up only when the risks of failure are reduced to a minimum. A careful analysis of the subject will thus make it amply clear that it is not at all desirable to start large factories recklessly.

Moreover, it would be very unwise for one to launch in the industry with heavy liabilities with-

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out having at first acquired an expert knowledge of the working of a large factory and of all the necessary conditions, contributing to its success or failure. Time, however, may come when the system of manufacturing matches with splints and boxes, bought from forest factories, to which I have referred in a previous chapter, may have to be extensively applied, specially when export trade with countries outside India may have to be undertaken, and this will mean employment of machines of a larger capacity in a larger measure.

But for the present it is necessary that the manufacturers should devote a greater attention to improving, cheapening, and popularising, their existing small machines, so that they may be used for cottage industry as freely, as the Singer's sewing machine or a treadle printing machine. If

they succeed in this matter it will be of a greater value to the country than that derivable from large factories, run on capitalistic basis. The modern factory system, involving the conflict between labour and capital is moreover, not an ideal, we should aim at. The cottage industry, which the invention of Dr. Nandi has widened in scope and application, should be regarded as a blessing to the Indian people in their present stage of transition and we should do all in our power to promote the success of this nascent national enterprise.

The total quantity of matches, imported from foreign countries into India in 1919-20, 1920-21, and 1921-22 was 12,445,163, 9,723,952, and 11, 775, 120, respectively. From these figures it may be concluded that there is room enough in India for the establishment of about 1500 small factories, each with an output

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of about 30 gross of match boxes per diem, to supply the entire demand of the country.

From the estimate of a factory, yielding 30 gross of match boxes per diem, kindly supplied to me by the Bhowani Engineering and Trading Company and appended to this book (vide Appendix B, it appears that such a factory, under the present system, will provided 44 hands, including children, which means the employment of about 66,000 hands in all for the factories required. But this number could be reduced to any figure if our country were suitable for the establishment of large factories anywhere without restrictions, with an undoubted prospect of success. But we may really congratulate ourselves, from the labour point of view, on the circumstances that these factories have not hitherto tempted investors, as I have already stated.

There is another important aspect of the industry. Those who know the poverty of our country and of our middle classes in particular need not be told how very difficult it has now become for them to make a living. The number of respectable, families, silently suffering poverty, throughout the whole country, is enormous. Death from starvation, selling of girls of tender age to old decripts under cloak of marriage, living on one meal a day with small children, and the use of rags, by woman insufficient to cover their bodies are daily incidents in the life of these hapless families. In towns like Calcutta it is difficult to form an idea of the real condition of India ; towns are really like white shrouds, decked with flowers, hiding from view the coffin that contains the corpse. The world outside has no source of knowledge of this appalling condition of the middle classes of our town and

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country ; for, they would rather die than let any outsider know of their condition and would rather starve than go about begging, even according to the modern civilized method of demanding relief, which they hold to be derogatory to the prestige of their families.

The poverty of the middle classes may be partially understood if we look at the number of candidates, the heads of these families, applying for any trifling post, the pay of which may not be enough for a single man,—their attempt at securing even a position so humble displaying the eagerness of dying men catching at straws.

This industry offers to mitigate, to some extent, the sufferings of these desparate people.

Out of the 44 hands, required to run a small factory, we can mention the work done by about twenty consisting of frame filling

and box making, as suitable for these families to be done in their own respective places of residence in the locality. The daily expenditure of a factory under this head amounts to about Rs. 5/- which may be shared by a few families according to the quantity of work done by each. The work is quite simple and can be done even by children. The manager of the Cussins' Match Works informed me that for his factory the above work used to be done by poor women of the locality in their own homes, for which they were properly remunerated. So, if this system is maintained, it will provide a suitable source of income for these families, enabling them to earn something by home work.

But some of the match-manufacturers are of opinion that the industry cannot stand unless some sort of automatic machinery for frame filling

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purposes is devised and added to the equipment of a factory. This is not always correct and I can only refer them to the system, adopted by certain other manufacturers, working on the above line, as also to the fact that the invention of frame filling devices in Europe is of a comparatively recent date, before which the work had to be done by hand and this ought to disabuse their minds of this idea.

Manufacturers of match machines are, however, trying their best to make some automatic machines for frame filling and the experiments conducted by some of them have inspired them with hope, and they are confident of being able to supply them soon to their customers.

But it is to be hoped that these machines will be used only in places where the work cannot be carried on under the system, I have mentioned above, or where the output being very large it may appear unworkable.

From the humanitarian point of view we hope labour saving devices will not be used to depriving labour, and to add to the miseries of the people

It is a deplorable fact that there is a class of manufacturers of matches, who are not only producing matches of a very bad quality but are freely ventilating their opinion that the industry is not a paying one. I saw samples of matches made by some of these unsatisfactory class of manufacturers and it gave me great disappointment when I compared them with those made by certain manufacturers of high class matches in the various provinces of our country. It will be apparent even to a casual observer that when all these matches are made by the same kind of machines and with the same materials, the difference in their quality cannot be of such a striking nature, one approaching the best Swedish matches in

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quality and in execution, and the other failing to claim superiority even over the worst class of Japanese matches, unless there is a gross carelessness on the part of manufacturers or their ignorance of work or both, to account for it. It appears that there is a general inclination of the intending organisers of match-factories to buy machines and other appliances to use at once without having received any training in the work. This, in many cases, brings about failure and hence the necessity of learning the work in all its details before starting the business cannot be over-estimated. The method adopted by manufacturers of high class matches ought to be thoroughly learnt and important points thereof carefully noted by one desirous of achieving success in the industry.

A trained man in the field can easily make a net income of about Re. 1/- at the present rate of the

market, per gross , but it may seem difficult for one producing bad stuff to earn even a few annas

Some of the common defects, found mostly in matches of an inferior quality may be summed up below —

1 Too much or else insufficient tipping of the splints, the former giving an explosion not without danger of particles flying into the eyes of the person striking the match, and the latter not igniting at all

2 Use of too loose paste for side painting This causes the rubbing surface to be quickly torn and destroyed

3 Shortness of the size of the inner tray which causes it to drop from its outer cover This is a source of much annoyance to the consumer

To avoid these and other defects it is highly desirable that the work of a factory should be closely supervised and attention given to every process

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of manufacture from the first to the last

The cost of production of matches varies according to local conditions, specially in regard to the price of wood and labour. But ordinarily it makes no large difference. If, in a place where all these things are cheap, the cost of production of one gross amounts to about Re. 1-4, it may rise to about Re. 1-8 in a place where the conditions are otherwise.

At present when the Swedish and the Japanese matches of the best quality are being sold @ Rs. 2-12 per gross, there is practically an unlimited prospect for manufacturers of matches in India, provided they devote their whole hearted attention to the industry and make their matches as good as possible under the prevailing conditions. When some of them are able to manufacture matches of such superior quality, one feels

tempted to expect them all to effect improvement at least on the same level of excellence. In a field where competition is so easy with foreign manufacturers because of the high price they have to charge for their matches on account of their being required to pay an import duty of Re 1-8 0 per gross, no Indian manufacturer ought to lag behind instead of trying his best to win the highest reward by realizing the best value for the work done by him. When it is obvious that a manufacturer who succeeds in making good matches can earn Re 1 per gross it is better to keep to a smaller output devoting a greater attention to finish, so as to sell at the highest price obtainable in the market. Large production and bad finish are not only worse than small production and attractive finish but the former ultimately ruins the business, destroying its credit in the market. So everybody

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should at first try to make really useful and good matches, however small the output may be ; for, so long as his work is satisfactory, he is sure to be led to a success.

The Government of India deserve thanks from all the Indian manufacturers of matches for having given them a timely protection by the imposition of an import duty on matches at the rate specified above which, has made it possible for the industry to achieve so much success within this short time. Without this aid it would have taken us years before we could have entertained even an idea of competing with the foreign manufacturers in the field. This is certainly the most opportune moment for the development of the industry ; for, factories, established at present, will not only be able to tide over their initial difficulties, from the financial point of view, in a most effective manner but will be able to

set aside some profits every month to face any difficult situation that may arise in future.

The numerical strength of small factories is of no less importance in its relation to the future of this industry, as it is quite possible that at any moment a large factory may be started in a suitable site in India, financed by a foreigner, specially in view of the increasingly voluminous expert opinions that are gathering strength, unanimously supporting the contention that the industry has a great future if it is conducted on proper lines. There is no lack of enterprising capitalists in the world, ready to invest any amount, large or small, in any business and in any part of the globe, provided the investment is safe and the profits are sufficiently attractive. If at present any foreign capitalist takes up manufacturing matches in India and his attempts prove a success, it will

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invite more and more foreigners into the field till at last all the suitable sites, recommended by experts for match-manufacturing purposes on a large scale, are taken possession of and utilised by them

Besides it is natural that persons interested in the sale of matches and match machinery, imported from abroad, might be trying their best to spread any amount of half truths to injure the cause of the industry. They may appoint any number of people in any part of the country to help them in their propaganda, and we all know what this might lead to

But if before such a situation is created, a large number of small factories could be established almost in every district of our country, each co operating with the other, it would be difficult for large factories to compete successfully with them in the market. Their success in the strife

will depend on their numerical strength and on the strength of their capacity to combine. It is, for this reason, desirable that there should be a match-manufacturers' federation, represented by all the manufacturers of matches in India, which may meet from time to time at a convenient place to discuss matters of general interest in connection with the industry. It will not only be possible for such a body to offer a most effective resistance to their common enemy but also to find out ways and means to solve other difficulties that may arise from time to time, each manufacturer profiting by the experience of the other.

In Bengal, the Director of Industries and his Department have shown the keenest possible interest in the Industry, and desire to see it placed on the best footing. They have spared no pains to help manufacturers in various ways and get information

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useful to them from all sources. The Industry has also been able to include many distinguished and educated men in almost every part of our country among its patrons and well-wishers. So long as it has such friends to look upon for help and guidance, we can be safely confident about its future success.

APPENDICES.

D I X A.

WOOD.

Names).

Telugu	Nepalese	Burmese	Where available
			North-west Himalaya from the Indus to Nepal at 4-10,00
	Cherinangri	Segabin	North Bengal, Assam Khasia Hills, Tenas- serim and Upper Bur- ma
Pedu pey Pedda manu			Indigenous in the Pen- insula of India.
Peru			Western Ghats
	Utis		Himalaya from the Ravi Eastward at 3 9,000ft. Khasia Hills, Upper Burma in the hills at 6,000 feet.

APPENDIX A.]

	Assamese	Bengali	Oriya	Hindi	Tamil
6.		Chakwa	Panchi Pasi		Numma
7	Roghu	Kadam Karam Bolkadam.	Kodambo	Kaddam Karam	Vella- Cadamba Vellaika- dambai Kadambai
8.		Semul Thula			Kattu- elavam
9.	Bolchu Panchu	Semul Simal Simul Shembal Semur Pagun Somr	Bouro Burga Buroh	Same as Bengali.	Illavam Illavu Pula Parutti Pongima- ram, Ola- gamaram Mulila- vam

Telugu	Nepalese	Burmese	Where available
Pachimanu		Yon	Along river banks in
Panchman			the North Circars, Vi-
Paunchinan			zagapatam & Godavari,
Bucha			Central Provinces,
Karum			•Orissa, Chotanagpur ,
Pashi, Pansi			mixed forests of Chitta-
Pausi			gong & Burma; Com-
			mon in the latter pro-
			vince
Kadambe		Mau	Sub Himalayan tract
Kadamba		Mau Gaung-	from Nepal eastwards,
Kamba		don, Mau-	Eastern Bengal &
Rudrak		kadon	Assam , North Cir-
shamba			cars, Cuddapah and
Dudaga			Kurnool, West coast in
Peddakamba			Kanara and Malabar,
/			Burma.
		Didu	Burma, Andamans,
		Didok	Chittagong, Kanara
Burga		Letpan	Common throughout
Burgi			India and Burma, as
Burgu			cending to 3,500 ft
Baraga			
Buruga			
Buraga			

Telugu	Nepalese	Burmese	Where available
Anduku			
Anduga			
Andaka			
Guggilam			Common on dry hills
Parangi			throughout India ex- cept in Assam
		Ankchinza	Common in Burma
	Lampat	Myaukngo	Sub Himalayan tract
		Maulettanshe	from Nepal eastwards
			Assam Khasia hills,
			Manipur, Chittagong
			Andamans and Nico-
			bars Burma, common
			near streams
Paldatam		Gyaung byu	Throughout India
Poka			and Burma in decidu-
Pogadi			ous forests
Reddi			
Pul mera			
Giduguri			
Seregadi			

Telugu	Nepalese	Burmese	Where available
	Bhadras Batrach		Eastern Himalaya, 6,000-8,000 ft Khasia Hills, Sylhet, Mani- pur, Tenasserim
	Mowa Mahau	Taung lama- sok, Pet Sut Thitsawbwa	Sub-Himalyan Tract and outer hills, ascen- ding to 6,000 ft from the chenab east- wards, Assam, Khasia hills, Mampur Chitta- gong, Burma up to 6,000 ft.
Mula Modugu	Fullidha	Kathit	Throughout India and Burma chiefly in dry forests
	Kantukpa		Eastern Himalaya, 4,000 to 7,000 feet, Khasia hills
Thilla Chilla		Tayaw Kayaw	Coast and tidal forests of India, Burma and the Andamans Com- mon in the Sundar- bans

[List of Woods]

Telugu	Nepalese	Burmese	Where available
Garuga	Dabdabbi		Throughout the greater part of India and
Garga		Chinyok	Burma and in the
Gargu			Andamans and Cocoa
Gorugu			Islands
Gorugundu			
Tella Punki			Dry forests on the
Tella Puliki			Western Ghats Dec
Petiri Puliri			can Mysore and the
Puliki			Carnatic
Pithari poliki			
Kameraponiki			
Gummadi			Throughout India and
Gumitaku		Yemane	Burma
Peddakummi Gumbari		Yamane	
Geemmadi			
tekku			
Tigumuda			
nelagunadi			
Gumar Tek			
Peddagomru			
Gumudu			
	China		Himalaya from Kuma
			on to Bhutan 57000
			feet hill ranges of
			Burma

Telugu	Nepalese	Burmese	Where available
Namli			Throughout the greater part of India and
Nemali		Myaukseik	Burma
Navili		Pyaukseik	
Tapasi			
Tairsi			
Nali			
Pedde-Navali			
Pedda Nowli- eragu			
Udiyetta			Throughout India, in
Pottaka		Kusan	dry deciduous forest
Dudippa		Kuthan	and often in sal for- ests, dry forests of
Chetippa			Burma
Chedippa			
burja			
Monnbhabilly			
Baudara			
Banderu			
Monnabilla			
Potri		Dwabok	Throughout India and
Pandika		Dw dok	Burma, chiefly in deci-
Kondipetta	Kubinde	Tabo	duous forests, not in
Putchebotuka		Myethlwa	the arid region
Erakuthaddo			
Peddapotri			
Peddakunji			
Kondapatti			

[*List of Woods*

Telugu	Nepalese	Burmese	Where available
		Leza	Common in mixed deciduous forests in Burma
			W Ghats from the Konkan Southward, in evergreen forests and on river banks
Kumkuma	Sinduria	Taw	Sub Himalayan tract
Vessuntagunda		Chidin	from the Indus eastwards Bengal, Central Western and Southern India, Burma and Andamans.
Chendra			
Sinduri			
Adivagbatadu			
Pachi chettu			
Vassanta			
Vessan			
thugundi			
Nagaruthu			
Adavi			
gubba			
Thodu			
Sunda			
ragundi			

Evergreen forests at the foot of the West ghats from the Konkan Southwards

[List of Wood

Telegu	Nepaese	Burmese	Where available
Gumpini			In deciduous forests throughout the greater part of India and Burma as also in the Andamans.
Gumpani			
Gumpina			
Gumpana			
Dumpini			
Dumpri	Baradabdabi	Nabe	
Dumper	Halloray	Hnabe	
Dumparti			

Himalaya from Bhutan westwards at 6 12,500 ft extending into Afghanistan and Kafiristan.

Tinyu Khasia, Naga and Lusha Hills, Manipur Chin Hills Upper Chindwin and Shan Hills and other mountain ranges of upper Burma and Sittang and Salween Hills in lower Burma at 2,500—7,000 ft.

Telugu	Nepalese Baxgikat	Burmese	Where available Himalaya, from Kash- mir to Bhutan, at 4 10,000 ft
	Hattipaila	Taung petwun	Sub Himalayan, tract from the Jumna, east- wards, Bengal, Khá- sia hills Manipur, Chittagong Burma, Ghats of north Kanara and Andamans
			Himalaya from the Indus to Bhutan at 5 10 000 ft
		Momaka yethabye Yené	On river banks and moist places almost throughout India and Burma

Telugu	Nepalese	Burmese	Where available
Jirijidi Nella Jedi	Bhalai		Sub-Himalayan tract from the Beas eastwards, Assam, Khasia hills, Chittgong, Central India and the Indian Peninsula
Aravi Mamadi Kondamamidi Adavimamidi Amatum	Amara	Gwe	Throughout the greater part of India and Burma and the Andamans and Cocos Islands
		Binga Hnav- thein	Common in Chittagong Andamans and Burma,
	Muslimi	Letkok	Northern and Eastern Bengal, Burma, Andamans & Cocos Islands
Tabso Poliki Tella Poniki Konda tamara Yerru polki			Sub Himalayan tract from the Ganges eastwards in dry deciduous forest throughout the Peninsula and on the hills of Rajputana, Central India and Bebar, also in dry forest in Burma.

Telugu	Nepalese	Burmese	Where available
Tellapolika		Shawnu	Common in forest throughout the greater part of India and Burma and the Andaman & Cocos Islands
Pulaka			
Ped la manu			
Pohla			
		Thayetkin	Chittagong & Burma
		Thayetsan	
			in Tropical forests & along rivers, common in Arracan
	Kharanu		Eastern Himalayan from Nepal to Bhutan Khasia Hills
Garum	Yehmoyok		Sub-Himalayan tract from the Jumna eastwards ascending to 3,000 feet, Assam, Khasia hills, Bengal, Indian Peninsula and Burma.
Gamaru	Set kadon		
Kurong			
		Tanksha	Assam, Garo hills, Cachar Eastern Bengal, Chittagong, Andamans and Burma.
		(

In Bhopal (Central India), the following species of wood, suitable for match-making purposes, are available in abundance.

1. Gurjan.	} Local names.
2. Correh or kan	
3. Semul.	
4. Gadala.	
5. Bajor Batta.	
6. Amra.	
7. Adhasese.	
8. Gula.	
9. Gonda.	
10. Salar.	

A Burmese, gentleman, himself a manufacturer of matches in Burma, told me sometime ago that Lapan, Meaw and Tharazine (white), which are available in the Arracan Division, can be used even without paraffining.

APPENDIX B.

ESTIMATES FOR A MATCH FACTORY

(Supplied by the Bhowani Engineering & Trading Co., the Match-Machine Manufacturers,

122 1, Upper Circular Road, Calcutta,
based on their experience)

Calculation of daily expenses of a safety match factory with a daily output of 4320 (about 30 gross) boxes each box containing about 70 matches

I MATERIALS WITH QUANTITY

	RATE			TOTAL COST		
	Rs	As	P	Rs	As	P
8 cft of filed wood for splints & boxes	0	14	0 per cft	7	0	0
8 lbs Paraffin ...	0	6	0 per lb	3	0	0
13 lbs Chemicals .	0	6	0 „	4	14	0
3 lbs Arraroot for paste	0	3	6 „	0	10	6
4500 Labels for outer cases	0	6	0 per 1000	1	11	0
6 lbs Paper in sheets for boxes .	0	7	6 per lb	2	13	0
3 lbs Paper for packing	0	4	0 „	0	12	0
$\frac{1}{2}$ lb Lubricating Oil for Machine	0	10	0 per lb	0	5	0
2 Mds Fuel for Drying Chamber	0	8	0 per Md	1	0	0
				<hr/> Total Rs		
				22	1	6

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II. WAGES.

Cross cut saw—

Man 1	Cross cut saw —								
Boy 1	0	10	0				
	0	6	0		0	10	0
Splints and Box Veneers Department							0	6	0
Automatic									

Splints and Box Veneers Department—

Automatic Rotary Type Chopping Machine and Hand Chopper—

Men 3	...	...	0	10	0				
Boy 1	...	...	0	6	0		1	14	0
							0	6	0

Drying, polishing and cleaning apparatus :—

Man 1	...	...	0	8	0				
							0	8	0

Laboratory :—

* Chemist 1	...	...	1	0	0				
Man 1	...	...	0	8	0		1	0	0
							0	8	0

§ Frame filling department —

Boys 15	...	...	0	4	0				
							3	12	0

§ Box Making Department —

Boys 5	...	...	0	4	0				
							1	4	0

Dipping Department, —

Men 2	...	...	0	10	0				
							1	4	0

Packing Department —

Boys 2	...	...	0	4	0				
Men 2	...	...	0	8	0		0	8	0

Sundries, —

Man 1	...	...	0	8	0		1	0	0
Boy 1	...	...	0	4	0		0	8	0
							0	4	0

Total Rs. 13 12 0

* Expenses on this account may be saved if the proprietor works as chemist. —

§ This may be done on contract system from outside the factory.

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III. OFFICE STAFF.

*Manager 1	..	2	0	0	2	0	0	
Clerk 1	1	0	0	1	0	0
Darwan 1	0	12	0	0	12	0
						<hr/>		
Total Rs						3	12	0

IV GENERAL EXPENSES

Business expenses of all							
sorts	1	0	0		1	0	0
Repairing of Machinery,							
advertising etc	1	0	0		1	0	0
§Rent for the factory shed	2	0	0		2	0	0
					<hr/>		
					Total Rs.	4	0 0

RECAPITULATION

1	Materials	22	1	6
2	Wages	13	12	0
3	Office staff	3	12	0
4	General expenses	4	0	0
		<hr/>		

Grand Total Rs 43 9 6

* Expenses on this head may be avoided, if the proprietor serves as Manager.

§ There are many places in India where the expenses on this head may be reduced to half the amount mentioned or saved altogether by the construction of a shed at a small cost. Of course the latter course is possible only where the land is cheap or where the proprietor of a factory may have some to spare for the purpose.

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Sale price of 30 gross matches @ Rs 2/ per gross less
broker's commission @ 5 p.c. Rs 57 0 0

Cost of manufacturing 30 gross Rs 43 9 6

Profit per day Rs 13 6 6

or Rs 16 6 6 if the services of a salaried Chemist
and Manager are dispensed with

1 COST OF MACHINERY WITH COMPLETE ACCESSORIES

* 1 Automatic Chopping Machine Type 'B'	800 0 0
1 Hand chopper	150 0 0
1 Drying apparatus with cleaning and polishing drum and paraffining hearth etc	500 0 0
100 Filling frames each frame to contain splints for 1 doz match boxes @ Rs 5/ each	500 0 0
6 Phosphorus frames @ Rs 6/ each	36 0 0
1 Grinding Machine with stone	50 0 0
2 sets of Dipping Trays @ Rs 20/ each	40 0 0
2 sets of scale @ Rs 5/- each	10 0 0
2 Pestle and mortar @ Rs 15 each	30 0 0
1 Oil stone Rs 5/	5 0 0
1 Hydrometer Rs 10/	10 0 0
1 Doz brushes	6 0 0
10 Inner box moulds @ Re 1/ each	10 0 0
Furniture and small tools	250 0 0

Total Rs 2397 0 0

2 WORKING CAPITAL

Rs 1500 0 0

Cost of machinery and working Capital Rs 3897 0 0

* A peeling machine the price of which is Rs. 1000/ may be used if veneers for boxes are to be obtained by peeling the chopping machine, being used only for making splints.

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BEHULA

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